19. A process according to claim 17, wherein the solidified material is leached with an alkaline leachant.

20. A process according to claim 19, further comprising leaching the alkaline leached solidified material with an acid leachant.

21. A process according to claim 17, wherein the alkaline leachant is caustic soda.

22. A process according to claim 17, wherein the titaniferous material is heated to a temperature of at least 1000°C.

23. A process according to claim 17, wherein the titaniferous material is heated under reducing conditions.

24. A process according to claim 23, wherein the titaniferous material is heated in the presence of a solid carbonaceous material.--

REMARKS

The Office action of June 25, 1996 has been carefully considered.

The application has been objected to as not containing an Abstract of the Disclosure, and an Abstract of the Disclosure has now been added.

LAW OFFICES
DENNISON, MESEROLE, POLLACK & SCHEINER
612 CRYSTAL SQUARE 4
1745 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VIRGINIA 22202
703 412-1155

Claims 1 through 16 have been rejected under 35 USC § 112, second paragraph, as being indefinite on several grounds. Numerous objections have been raised regarding Claim 1, and Claim 1 has now been cancelled and rewritten as new Claim 17. It is noted that new Claim 17 has omitted the term "glassy," and utilizes terminology generally in proper accordance with U.S. practice.

It is further noted that Claim 2 has been cancelled and replaced with new Claim 18 reciting the additives of Claim 17 in proper alternative form.

Withdrawal of this rejection is requested.

Claims 1 through 16, have been rejected under 35 USC § 103 over Heikel '916, France 1,066,777, Leary '438, Pollard '934, Stewart '099 or Stewart '929. Applicants submit that the presently claimed invention is patentable over the cited references.

The claimed invention is directed to a process for upgrading a titaniferous material by heating with an additive that promotes the formation of a liquid oxide phase containing the impurities at the temperature of heating, forming a solid titaniferous phase and a liquid oxide phase containing the impurities. This combination is then cooled to form a solidified material comprising a titaniferous phase and an

LAW OFFICES
DENNISON, MESEROLE, POLLACK & SCHEINER
612 CRYSTAL SQUARE 4
1745 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VIRGINIA 22202
703 412-1155

impurity containing phase that is leachable in an acid or alkaline leachant. The leachable material is then leached with an acid leachant, an alkaline leachant or a sequential combination of the two, to leach at least a portion of the impurities.

The Heikel patent discloses a process for preparing titanium dioxide in which a titanium-bearing material is contacted with an alkali metal compound which may be an alkaline metal hydroxide, carbonate or oxide. This combination is roasted, digested in an acid and calcined. The Heikel patent, however, does not disclose or suggest the formation of a liquid oxide phase separate from a solid titaniferous phase, the liquid oxide phase containing impurities from the titaniferous material upon cooling to a solid phase.

French Patent 1,066,777 discloses a process for producing titanium concentrates in which the titanium-containing mineral is heated with a flux and reducing agent at a temperature such that a titanium-containing slag and molten iron form, and these are separated. The slag is then treated with dilute sulfuric acid to remove the soluble compounds.

The French patent does not disclose the step of heating the titanium-containing mineral with an additive to

LAW OFFICES
DENNISON, MESEROLE, POLLACK & SCHEINER
612 CRYSTAL SQUARE 4
1745 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VIRGINIA 22202
703 412-1155

form a liquid oxide phase containing impurities; rather, it is the titaniferous phase that contains the impurities which is separated from a molten iron phase.

The Leary patent discloses a process for separating a titanium-rich component from a titanium-bearing material that also contains iron. According to this process, the mineral is heated at a temperature of 350 to 650°C in the presence of a flux such as potassium hydroxide, so that the titanium dioxide dissolves in the flux and iron oxide remains as a solid. The process further comprises heating the mixture at an elevated temperature in the presence of carbon monoxide and water to convert the iron oxide into magnetite and to precipitate the titanium dioxide as a material containing titanium, oxygen and hydrogen. Leary does not disclose or suggest heating the titaniferous material in the presence of an additive which promotes the formation of a solid titaniferous phase and a liquid oxide phase containing impurities in the mineral.

The Stewart et al '099 patent discloses a process for upgrading a titaniferous ore such illmenite comprising reducing an iron oxide component of the ore to metallic iron and separating the metallic iron from titanium dioxide. This process involves mixing the ore with the flux and reducing the

LAW OFFICES
DENNISON, MESEROLE, POLLACK & SCHEINER
612 CRYSTAL SQUARE 4
1745 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VIRGINIA 22202
703 412-1155

mixture with a solid carbonaceous material without sintering or melting. The flux is preferably an alkali metal or alkaline earth metal salt, particularly a chloride or sulfate.

Stewart et al '099 clearly teaches against the formation of a liquid phase, and therefore does not disclose or suggest forming a liquid phase containing impurities at a temperature less than 1300°C by use of an additive which promotes such a phase.

Stewart '929 is related to Stewart '099, and relates to a process for producing metallic iron from iron oxides by heating an oxide containing material in the presence of hydrogen chloride, flux and a solid carbonaceous material to a temperature below that at which slag is formed. While the source of the iron may be a titaniferous material, Stewart et al '929 once again teaches heating to a temperature below that at which melting takes place. To the contrary, the presently claimed invention takes place including the step of forming a liquid oxide phase containing impurities.

Pollard et al discloses a method for removing iron from an oxide-containing material by heating with a solid carbonaceous material in a molten salt bath at a temperature of 750 to 1300°C. The molten salt bath comprises at least one alkali metal or alkaline earth metal chloride, and optionally

LAW OFFICES
DENNISON, MESEROLE, POLLACK & SCHEINER
612 CRYSTAL SQUARE 4
1745 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VIRGINIA 22202
703 412-1155

contains a hydrogen chloride generator. While the salt bath is melted, the result of the process is considerably different from the presently claimed invention. Note from Example 1 at column 3, lines 27-34, that the cooled reaction mixture contains three phases: a first phase which is highly magnetic and contains metallic iron - carbon composites, a non-magnetic fraction containing essentially pure titanium oxides, and intermediate fractions comprising titanium oxides with residual iron. This is not the result of the presently claimed invention, in which a titaniferous phase separates from an impurity-containing phase which is leached.

Thus, none of the cited references discloses or suggests a process in which a titaniferous material is heated with an additive which promotes the formation of a liquid oxide phase, cooling the combination to produce a solid titaniferous phase and a solid phase containing impurities, and leaching the solidified material with an acid or alkaline leachant, or combination thereof, to leach at least a portion of the impurities. Withdrawal of this rejection is accordingly requested.

Applicants note that new Claims 19 through 24 have been added to the specification. Claims 19 and 20 specify leachants otherwise specified in alternative form in the

LAW OFFICES
DENNISON, MESEROLE, POLLACK & SCHEINER
612 CRYSTAL SQUARE 4
1745 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VIRGINIA 22202
703 412-1155

claims, Claim 21 specifies that the leachant is caustic soda, as disclosed at page 9, line 5, of the specification, Claim 22 specifies that the heating step takes place at a temperature of at least 1000°C, as disclosed in the specification at page 9, line 26, and in Examples 1-4, and Claims 23 and 24 relate to reducing conditions in the heating step as disclosed at page 10, lines 9 through 12.

Applicants submit herewith a supplementary search report from the corresponding European application, together with one of the references cited therein.

It is noted that U.S. Patent No. 4,759,916 has already been cited in the present application and that EP 243,725 corresponds to Australian patent application 70976/87 cited in the International Search Report for the present application. A translation of French patent 1,017,792 is attached hereto.

The French patent discloses a process for removing chromium and other impurities from titanium-bearing minerals and concentrates by mixing together the minerals with substantial amounts of sodium compounds and roasting the mixture to form sodium titanites which are insoluble and thereby release chromium and other impurities which are then leached. The sodium compounds are added for the purpose of

LAW OFFICES
DENNISON, MESEROLE, POLLACK & SCHEINER
612 CRYSTAL SQUARE 4
1745 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VIRGINIA 22202
703 412-1155

consuming titanium, not to form a liquid oxide phase which forms a leachable impurity bearing phase.

In view of the foregoing amendments and remarks, Applicants submit that the present application is now in condition for allowance. An early allowance of the application with amended claims is earnestly solicited.

Respectfully submitted,

Ira J. Schultz
Registration No. 28666

LAW OFFICES
DENNISON, MESEROLE, POLLACK & SCHEINER
612 CRYSTAL SQUARE 4
1745 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VIRGINIA 22202
703 412-1155